DEPARTMENT OF HEALTH

Industrial Radiography Public Exposure

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Incident Timing

- Incident on 1/11/2019 in Silver Bay – potential overexposure to a member of the public
- MDH notified 1/14/2019 – on way for routine inspection in Duluth
- Visited the site on 1/22/2019

Tank Weld

- Scaffolding set up in tank (source side)
- Lift used outside tank (film side)
- Lift required qualified operator (tank fabricator)
- Communication through manway

Incident

Details

- Iridium-192 – 67.4 Ci
- Steel Thickness:
  - 3/8” below
  - 5/16” above
- 40 second exposure
- Source 12 inches from tank surface
- Distance from source to radiographer – 2-3 feet
- Distance from source to lift operator – 4 feet

Dose estimate

- Challenge – where was the lift for the duration of the 40 second exposure?

- Pocket dosimeter – 110 mR
- Landauer dosimeter – 135 mrem
- Calculated dose at 4 feet with 5/16 inch steel – 155 mrem
- Calculated dose at 4 feet with 3/8 inch steel – 143 mrem

Dose estimate

- Final dose estimate based on the Landauer badge of the radiographer with a calculation to account for the relative distances from the source at the stationary position.

- Dose was estimated as 76 mrem.

Radiation Dose to Public

How events involving a radiation dose to a member of the public are captured in NMED can sometimes be confusing. This article attempts to clear up some of the confusion. For brevity, the applicable CFRs are summarized; they are not copied verbatim. Please read the applicable CFRs for clarification, especially regarding whether the requirement to report an event is triggered on reaching a value or exceeding a value.

These events are also coded as reportable Overexposure events, only differing in that the NMED record's Reporting Requirement field lists the more restrictive reporting requirement.

Note that 10 CFR 20.2202 uses the term "individual" and is not restricted to only members of the public.

In addition to the 100 mrem in a year dose limit, there is a second requirement for protecting members of the public. 10 CFR 20.1301(a)(2)

NMED event – member of public could receive > 2 mrem in any one hour

receive greater than 2 mrem in any one hour in an unrestricted area?

- If a member of the public is present and receives a dose greater than 100 mrem, the event is coded as a reportable Overexposure event. The Reporting Requirement field lists 20.2203(a)(2)(iv) or the more restrictive requirements of 20.2202.
- If a member of the public is present but does not receive a dose greater than 100 mrem, the event is coded as a reportable Other event (not Overexposure). The Reporting Requirement field lists 20.2203(a)(2)(iv).
- If a member of the public is not present, the event is coded as a reportable event with the Other event type. The Reporting Requirement field lists 20.2203(a)(2)(iv).

- inform NRC when access is no longer needed
- serve as a point-of-contact for an annual validation of website users

The website access list is validated annually (typically in February) as follows:

- INL compares NRC personnel with access against an NRC roster (such as the NRC phone book or address book contained within NRC's email platform)
- INL emails Agreement State points of contact to validate personnel in their agency
- INL emails other Federal agency personnel and contract sponsors

Training Schedule

Thank you.

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20.2203(a)(2)(iv)

(a) Reportable events. In addition to the notification required by § 20.2202, each licensee shall submit a written report within 30 days after learning of any of the following occurrences:

(1) Any incident for which notification is required by § 20.2202; or

(2) Doses in excess of any of the following:

(i) The occupational dose limits for adults in § 20.1201; or

(ii) The occupational dose limits for a minor in § 20.1207; or

(iii) The limits for an embryo/fetus of a declared pregnant woman in § 20.1208; or

(iv) The limits for an individual member of the public in § 20.1301; or

(v) Any applicable limit in the license; or

(vi) The ALARA constraints for air emissions established under § 20.1101(d); or

(3) Levels of radiation or concentrations of radioactive material in—

(i) A restricted area in excess of any applicable limit in the license; or

(ii) An unrestricted area in excess of 10 times any applicable limit set forth in this part or in the license (whether or not involving exposure of any individual in excess of the limits in § 20.1301); or

(4) For licensees subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR part 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

20.1301 (a)

Each licensee shall conduct operations so that—

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with § 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

20.1301 (b)

If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

Calculation

Assuming the lift operator was 4 ft. from the source (constants from NRC's Health Physics Technology Reference Manual):
$\Gamma = 4.7\ R \cdot cm^2/hr \cdot mCi$
A = 67.4 Ci = 67,400 mCi
HVL = 1.3 cm (Ir-192 in steel)
d = 4 ft = 121.9 cm
t = 40 s = 0.01111 hr
x = 5/16 inch = 0.7938 cm
$\mu = \ln 2/HVL$

Dose from an unshielded source:

$$D = \frac{\Gamma A t}{d^2} = \frac{(4.7\ \frac{R \cdot cm^2}{hr \cdot mCi})(67{,}400\ mCi)(0.01111 hr)}{121.9^2} = 0.2368\ R$$

Dose from the shielded source:

$$D = D_0 \cdot e^{-\mu x} = (0.2368\ R)\left(e^{-\left(\frac{\ln 2}{1.3\ cm}\right)0.7938\ cm}\right) = 0.155\ R \Rightarrow 155\ mrem$$

If x were 3/8 inch (the lower part of the tank), the dose would be 143 mrem.

- The licensee had calculated the dose as 156.23 mrem.